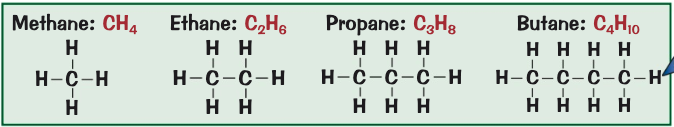
***Chemistry notes:***

***Topic 7 – Organic Chemistry:***

**Hydrocarbons**

A hydrocarbon is any compound that is formed from carbon and hydrogen atoms only.



* Alkanes
  + Alkanes are the simplest type of hydrocarbon
  + General formula
    - CnH2n+2
  + Alkanes are a homologous series
    - This means that they are a group of organic compounds that react in the same way
  + Alkanes are saturated compounds
    - This means that each carbon atom forms with four single covalent bonds
    - The bonds are all single bonds
  + The first four alkanes are methane, ethane, propane and butane
* Properties of a Hydrocarbon
  + The shorter the carbon chain
    - The runnier it is. (less gloopy) (the lower the viscosity)
    - The more volatile it is. (lower boiling points)
    - The more flammable it is.
  + The properties affect how they’re used for fuels
    - Having a lower boiling point means they’re used as bottles gasses
      * Meaning they’re stored as liquids under pressure
* Complete Combustion
  + A close up of a sign

    Description automatically generatedThe complete combustion of any hydrocarbon in oxygen releases lots of energy
    - The only waste products are carbon dioxide and water
  + During combustion, both carbon and hydrogen from the hydrocarbon are oxidised
  + Hydrocarbons are used as fuels due to the amount of energy released when they combust completely

**Fractional distillation**

* Crude Oil
  + Crude oil is a fossil fuel
    - It is formed from the remains of plants and animals, that died millions of years ago and were buried in mud
    - Over millions of years, with high temperature and pressure the remains turn to crude oil which can be drilled up from rocks where it’s found
  + Fossil fuels like coal, oil and gas are non-renewable fuels as they take long so long to make that they’re being used up much faster than they’re being formed
    - They’re finite and one day will run out
* Fractional distillation
  + Can be used to separate hydrocarbon fractions
  + Crude oil is a mixture of lots of different hydrocarbons
    - Most of which are alkanes
  + Method:

1. The oil is heated until most of it has turned into gas
   1. The gases enter a fractionating column
      1. The liquid is drained off
2. In the column, there’s a temperature gradient
   1. This means that its hot at the bottom and cooler as you go up
3. The longer the hydrocarbon, the higher the boiling points
4. As the hydrocarbons go up, they condense back into liquids and drain out of the columns
5. You end up with the crude oil mixture separated out into different fractions

A close up of a map

Description automatically generated

**Crude Oil:**

* Uses of crude oil
  + Oil provides the fuel for most modern transport, cars, trains, planes.
    - Diesel oil, kerosene, heavy fuel oil and liquid petroleum gas all come out of crude oil
  + The petrochemical industry uses some of the hydrocarbons from crude oil as a feedstock
    - To make new compounds for use in things like polymers, solvents, lubricants and detergents
  + All products you get from crude oil are examples of organic compounds
    - The reason you get such a large variety of products is because carbon atoms can bond together to form different groups called homologous series
      * These groups contain similar compounds with many properties in common
        + Alkanes, alkenes are all examples of different homologous series
* Cracking
  + Cracking is the splitting up of long chain hydrocarbons into shorter chain hydrocarbons
  + This is because:
    - Short chain hydrocarbons are flammable so make good fuels and are in high demand
      * However, long chain hydrocarbons form thick gloopy liquids like tar which aren’t useful
  + Cracking produces alkanes and alkenes
    - Alkenes are used as a starting material when making lots of other compounds and can be used to make polymers
  + Some of the products of cracking are useful as fuels
* How does cracking occur?
  + Cracking is a thermal decomposition reaction
    - This means the molecules are broken down by heating them
  + There are different methods of cracking, these include:
    - Catalytic cracking

Heat long-chain hydrocarbons to vaporise them (turn them into a gas)

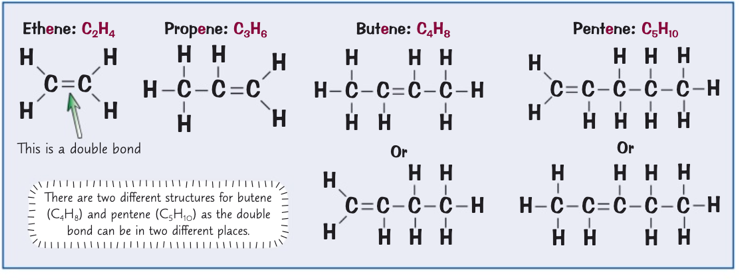
Then the vapour is passed over a hot powdered aluminium oxide catalyst

The long chain molecules split apart on the surface of the specks of catalyst

* + - Steam cracking

1. Heat long-chain hydrocarbons to vaporise them (turn them into a gas)
2. Mix them with steam
3. Then heat them to a very high pressure

**Alkenes:**

* Alkenes are hydrocarbons which have a double bond between two of the carbon atoms
* The C=C double bond means that alkenes have two fewer hydrogens compared with alkanes containing the same number of carbon atoms
  + This makes them unsaturated
* The C=C double bond can open up to make a single bond, allowing the two carbon atoms to bond with other atoms
  + This makes alkenes more reactive than alkanes
* The first four alkenes are
  + Ethene
  + Propene
  + Butene
  + Pentene
* Straight chain alkenes have twice as many hydrogen atoms as carbon
* General Formula for Alkenes
  + CnH2n
* Alkenes burn with a smoky flame
  + In a large amount of oxygen, alkenes completely combust to produce water and carbon dioxide
  + However, there isn’t enough oxygen in the air for this, so when you burn them they undergo incomplete combustion
    - Carbon dioxide and water are still produced
      * However, you can also get carbon and carbon monoxide which is a poisonous gas
    - Alkene + Oxygen 🡪 Carbon + Carbon Monoxide + Carbon Dioxide + Water (+Energy)
  + Incomplete combustion results in a smoky yellow flame and less energy being released compared to complete combustion of the same compound
  + Equation for incomplete combustion (example)
    - C4H8 + 5O2 🡪 2CO + 2CO2 + 4H2O

**Reactions of Alkenes:**

* Addition reactions:
  + A functional group is a group of atoms in a molecule that determine how the molecule typically reacts
    - All alkenes have the functional group ‘C=C’, so they all react in similar ways
      * So, you can suggest the products of a reaction based on your knowledge of how alkenes react in general
  + Most of the time, alkenes react via addition reactions
    - The C=C double bond will open up to leave a single bond and a new atom is added to each carbon
  + A close up of a clock

    Description automatically generatedAddition of Hydrogen:
    - Known as hydrogenation
    - Hydrogen can react with the double-bonded carbons to open up the double bond
      * It forms the equivalent, saturated, alkane
    - The alkane is reacted with hydrogen in the presence of a catalyst
  + Steam can react with alkenes to form alcohol